TH402

Corporate Cartooning

The art and science of computerized business simulation

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Introduction

This article is designed to explore the use of computer simulations to help develop managers. Beginning with a review of what computer simulations are and why organizations use them for management development, it explores what is required for their successful use. Next simulation design issues are explored in the context of an actual simulation and different approaches critiqued. Finally, simulation development is summarized in terms of specifying and choosing simulations.

Simulations - why and what

Business people are concerned with doing not just knowing. Reflect for a moment on the important things you have learned. Were they to do with doing something or just learning something? Now reflect on how you learned these things - was this in the classroom or through (bitter) experience. I suggest that in most instances, important learning is defined based on the use it is put to and generally it was learned from experience.

I suggest that an organization's learning strategy must extend beyond merely building knowledge. It must be directed towards developing people who make "wise" decisions and a key and necessary step in this process is gaining experience. Simulations provide for this.

What are simulations?

Simulations use a model to replicate the real world. Participants make decisions that are fed into this model that assesses their effect and produces several reports recording that effect. The participants review and analyze these reports before making the next set of decisions. This process (Figure 1) is repeated several times (usually six to eight), so that participants learn from their mistakes, explore business knowledge & issues, see the dynamic impact of their decisions and have their understanding challenged.

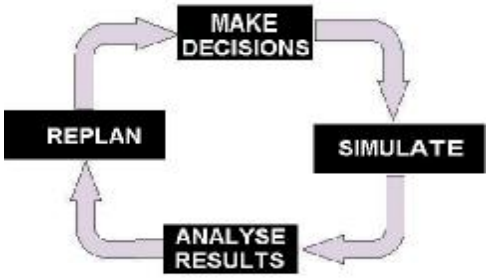

Figure 1: Simulation Process

Building wisdom

Often training and education, as exemplified by terms like ***"the knowledge driven society"*** focuses on building knowledge. This, I believe misses the point and, knowledge at the best, only provides the first step on the way to business success (Figure 2).

Learning for business people and most adults is concerned with improving business success. In turn, business success requires making wise decisions and this demands wisdom. Creating wisdom involves a combination of knowledge and experience. Yet, often, experience is developed on the job in an ad hoc, accidental way. I suggest that effective learning strategy must manage this development of experience. Further there is a need to share experience so that it is not confined to

a single individual. One way of ensuring that experience is built effectively and through it wisdom is using simulations to provide simulated experience.

Figure 2: from knowledge through simulated experience to wisdom

To build wisdom from simulated experience involves several things. First, for learning to be ensured I believe that the participating business people should work in small groups to:

- Share knowledge & experience
- Present, promote and negotiate views
- Develop business skills
- Handle uncertainty and ambiguity
- Develop critical thinking skills

Besides this, learning is ensured by the group being coached and challenged by a tutor - a tutor who facilitates the process and actively manages learning. This means experience is developed in a controlled and coached way and this differs from gaining experience "on the job" - a lonely and uncontrolled activity where time is rarely spent to reflect and review.

Types of Business Simulation

I am often hear people say "I have played a business game or simulation". My silent response is "only one". Today there are wide ranges of simulations that comprehensively cover management development needs. These can be divided into the following categories [1]:

- Total Enterprise Simulations
  - Appreciation
  - Strategy
  - Tactical
  - Totality
- Functional
- Other
  - Concepts
  - Planning
  - Analysis
  - Enhanced Negotiations

Figure 3: Simulation Classification

Total Enterprise Simulations model a complete business and, so cover finance, marketing, operations and, occasionally, product development. These divide into four sub-categories focusing on different needs. Appreciation simulations are simple and are used to provide a general management overview of business. Strategy simulations focus on the strategic development of a business and how the external environment, product development etc. influence this. Tactical simulations focus on the efficient, internal operation of a business and how managerial actions influence the efficient use of resources, waste etc. Totality simulations model a business without any particular focus.

Functional simulations focus on a specific functional area (sales, marketing, operations etc.). However, although the decisions focus on the functional area, the universality of money means that financial aspects are still important. Decisions cover both the strategic and the tactical operation of the function. Where the function interacts with other functions, these interactions are predefined (e.g. a manufacturing simulation might receive a predefined sales demand from the marketing function) or the other functions may operate automatically (so the pre-defined sales demand may be influenced by the inability to deliver).

The other simulations (concepts, planning, analysis and enhanced negotiations) use simulation models to address focused development needs. Concept simulations focus on a specific business issue and concept (such as product-life-cycle). Planning simulations involve the preparation of a business plan using a "What-If" model and so help participants explore the planning process and how managerial actions may influence business results. Analysis simulations use models to explore the practical use of techniques such as statistical forecasting or inventory planning, Enhanced Negotiation Role-plays add a simulation model to the process to allow for the objective evaluation of the impact of proposals.

Simulation Use

Simulations can be used directly by the participants (where each team of participants uses their own PC and printer). Or they can be used where the teams submit decisions to the tutor who then processes them on a single PC and printer. The choice of method of use depends on the availability of hardware, the type of simulation, the time available and the impact of computer use on the process.

Successful Use

There are several issues that impact the successful use of simulations:

- Learning Process
- The Tutor's Role
- The Technology's Role

And these must be taken into account when developing a simulation.

Learning Process

Because of my engineering background I use a systems dynamics model [2] to describe the learning process. My systems dynamics model (Figures 4, 5 & 6) is based on observation and discussion with trainers who have used simulation consists of these, three interacting dynamics:

- Work Load
- Understanding (Cognition)
- Feelings (Affection)

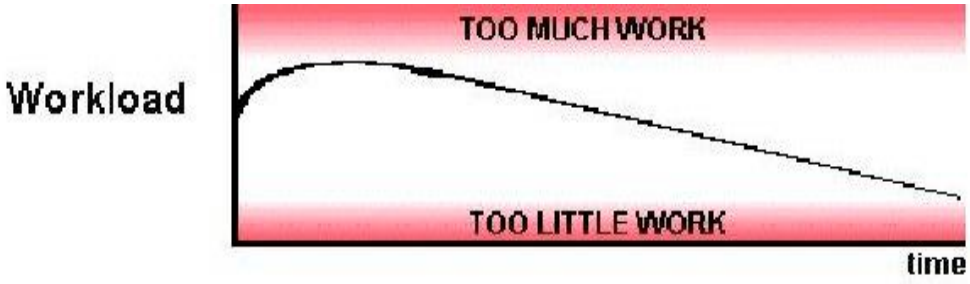

Figure 4: Workload Dynamic

Initially workload is high as teams learn about the simulation, their fellow team members and (if the simulation is interactive) about the other teams. As they gain familiarity workload falls.

Figure 5: Understanding Dynamic

Typically participants start the simulation somewhat confused but as time passes this confusion disappears as they climb the learning curve.

Figure 6: Feelings Dynamic

Typically participants begin the simulation in a state of excitement. However, they soon find the work harder than the expected and a little confusing. As the workload falls and as they learn, their **feelings** improve and they end feeling satisfied.

However, all these dynamics interact. Too much work at the beginning of the simulation or too little at the end will lead to dissatisfaction. Equally, too much confusion or too little learning can lead to dissatisfaction. Equally, if participants feel dissatisfied or feel the simulation pressures are too great this will affect their ability to make decisions and learn.

Tutor's Role

I separate the tutor's role [3] when running a simulation into the following:

- Administration
- Facilitation
- Managing Learning

Administration involves ensuring the smooth running of the simulation, the entry and processing of decisions and the calculation and production of results. Today, the bulk of this work has been delegated to the computer.

Facilitation involves rule clarification, support during the simulation (answering questions and reconciling results) and providing knowledge support (remedial teaching). This is a role that is shared by the tutor and the computer.

Managing Learning involves proactively ensuring learning takes place. I deliberately differentiate between it and facilitation to separate the (reactive) facilitation role from the (proactive) learning management one. Managing Leaning involves assessing learning (cognition) and feelings (affection). Deciding whether there is a problem with either or both, deciding what action (if any) should be taken and, if necessary providing cognitive or behavioral feedback. Managing Learning involves driving learning forward and, I believe requires the (human) tutor with the computer supporting the process.

Technology's Role

Where ever practicable tasks should be delegated to the computer software (simulator) and this should include the following:

- Administration
  - Compute Impact of Decisions
  - Produce Results
  - Help with Software
- Facilitation
  - Decision Screening
  - Explanations
  - Knowledge Support
- Learning Management Support
  - Special Tutoring Reports
  - Additional performance Analysis Reports
  - Comments on Performance

Figure 7: The role of technology

I will revisit this latter when discussing simulation design.

Design Approach & Issues

There are several issues and approaches that impact the design of a new simulation. These are as follows:

- The model & its development
- Ramped complexity
- Tutor support
- Customization & tailorability
- Software design

The Model and its Development

When you review the literature on simulation design you see a large part of it that emphasizes the need for the simulation being an exact, complex replica of the real world. This emphasis on reality and complexity is exemplified by this quote from one academic paper "management simulations are valid pedagogical tools provided they are complex and real"[4]. However, I take an opposing view. Instead of likening a simulation model to a "corporate portrait" I liken it to a "corporate cartoon"!

Like a cartoon in the "funnies" I see a model as a simplified and stylized representation. Also, like a cartoon strip, it is an evolving and insightful and something that challenges thought and perceptions. It should be memorable and focus on enlightenment rather than replicating the real world exactly. And, oh yes, it must be fun.

Why do I take this view? First because the two views predicate two different approaches to model building (this is something that I will detail later). Second, good models are usually stylized and simple. Consider the map of the London Underground railway. It is an icon of good modelling and the ideas incorporated have been used when mapping most of the world's subways. All the detail except the subway lines and stations has been eliminated. Further, in the center of London where the stations are geographically close together, the stations are spread apart. But, in outer London, where stations are geographically spread, the stations are closed up. So, despite the physical distance between stations the map shows them at reasonably fixed distances. Finally, in the interests of clarity the geography has been distorted. However, this focus is at the expense of general use. Specifically, you cannot use the London Underground map to assess distance on the surface. Stations that seem to be next door to each other can be miles apart!

The third reason for the Corporate Cartoon paradigm is that duration (the length of the simulation session) is highly correlated with complexity [5] and so complex models involve long training sessions - days rather than hours. So, the Corporate Cartoon paradigm, like a drawn cartoon, removes superfluous details to focus on the essential - learning

Model Development Process

Each of the two paradigms (Corporate Portrait and Corporate Cartoon) has design approaches associated with them. For the Corporate Portrait paradigm I describe the design process as a "Hunter-Gatherer" approach and for the Corporate Cartoon paradigm an "Engineered" approach.

The **hunter-gatherer approach** (Figure 8) begins with finding a business situation to model, the analysis of its structure and environment, identification of drivers etc.

1. Decide business to be modeled.
2. Analyze its structure and environment
3. Identify drivers (decisions and economic factors)
4. Define outputs and quantify relationships
5. Create Models
6. Produce Management Reports
7. Find Duration
8. Discover Learning Delivered

Figure 8: Hunter-Gatherer Approach

The first six steps are appropriate to developing a corporate planning model and as such are deceptively attractive. However, for a management development simulation, the weakness lies in the fact that the duration and the learning delivered are found at the end of the process (rather than defined at the start of the design).

Just as our forebears moved on from hunter-gathering to a modern society where our world is engineered for living, so to I feel that modern simulation design has

moved on to what I describe as the **engineered approach**. Here the design process (Figure 9) begins with the identification of learning needs and wants and then defines the deliverables in learning and teaching terms.

1. Specify Target Audience
2. Specify Development Objectives
3. Decide Duration
4. Define Issues
5. Decide Simulator Type & Manner of Use
6. Decide Business to be Modeled
7. Define Decisions/Results
8. Create Models linking Decisions & Results
9. Ramp workload and learning
10. Create Tutoring Support

Figure 9: Engineered Design Approach

I will illustrate this latter approach by discussing the development of an actual simulation that my firm is developing in partnership with a major UK university.

Case Study: Developing an Entrepreneurial Simulation

Earlier this year I was contacted by one of the UK's leading universities to develop a simulation in partnership with them to be used by students at the university and for my firm to use with my clients. The purpose of the simulation was to explore the issues and problems facing an entrepreneur setting up a small business. Thus, in contrast with prevailing simulations (that address the issues of medium to large, established, business), this simulation addresses the general management issues facing setting up a small business with limited resources and no established track record or customer base.

Target Audience

The university's the target audience for the entrepreneurial simulation was science and engineering undergraduates. A secondary audience was people considering starting business and those who are currently running a small business.

The determination of the target audience is important as it defines:

1. Participant's prior business knowledge
2. Their business experience
3. The group mix of experience & knowledge
4. Maturity & emotional factors

Figure 10: Affect of audience on design

In turn, this determination helps define the amount of on-line help and advice. Here, the simulation package would have to include mini-tutorials on finance, marketing etc. and reports that help explain and reconcile results. Had the users been more experienced with greater business knowledge, the on-line help and advice could have been more basic.

Development Objectives
Next, we specified development objectives**.** For this I use a five dimensional model [1] of needs.

1. Exploring knowledge & challenging understanding
2. Practicing & developing skills
3. Motivating & enthusing
4. Assessing learning & training needs & performance
5. Enhancing learning

Figure 11: Development Dimensions

Duration
Finally, the simulation's **duration** must be specified. Here, because of the simulation's scope, I suggested that it should last two days but could be spread over several weeks or months (with the students making the decisions in their spare time).

The specification of duration automatically defines the level of complexity that can be incorporated into the simulation and, specifically, the number of decision areas [5]. If the simulation is too complex, participants cannot reflect and think in the time available. If too simple then participants will feel that their time is wasted (Figure 4 - Workload).

Definition of Issues
The definition of the issues to be incorporated into the simulation is a vital stage as it allows one to focus on modeling these and not wasting development and training time with superfluous detail.

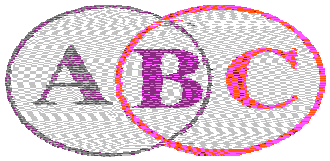

Figure 12: Issues Sets

In Figure 12 the issues addressed by the model are the set A + B. The issues required for learning are sets B+C. This means that the issues that are covered by the model and deliver learning is set B.

The next stage in the design was to research and define a list of key issues that would impact an entrepreneur setting up a new business. For example three of these key issues were cash flow & cash management, the use of the entrepreneur's time and marketing the product (both via conventional channels and the Internet).

Simulator type & manner of use
Because of the potential number of students involved and the nature of startup businesses it was felt that the simulation would be non-interactive (i.e. participating teams would not compete against each other but competition would be computer generated). This meant that it was attractive for the simulator to be used directly by the teams (with each team of participants using their own PC and printer).

Further, the issues identified for the entrepreneurial simulation reflected a focus on the internal (tactical) operation of the business and to adequately test the participants' ability to deal with ambiguity and uncertainty, the model must include random factors and variation.

The business to be modeled
It is only at this stage that the business to be modeled is considered and this differs from the Hunter-Gatherer approach where the business to be modeled would be defined at the very beginning. The choice of business modeled is based on the previous design stages.

For the entrepreneurial simulation the business:

- § should be a "real" product, but not one as we know it! That is to say it should be a product that might exist because of market needs but does not because of technological or economic factors.
- § a relatively simple business in marketing, operational and financial terms. That is to say the market structure and marketing mix should be straightforward. Product manufacture should consist of a single process with few component materials. Financing should be via an initial investment and bank borrowings.
- § should take into account the scientific and engineering background of the participating students and the product should be high tech and thoroughly modern!

Happily and luckily, I awoke in the middle of one night with the solution - a Cuddl-Etoy! This would be a soft toy (Figure 13) like a teddy bear. However, this would incorporate electronics that would link it to a normal home PC and communicate with a small child (between two and five years old). It would be used as a companion for the child and via the PC provides early learning.

Figure 13: Cuddl-Etoy

The introduction to the simulation stated that the Cuddle-Etoy was developed after a failed University project (where the toy was developed as an aid to diagnosis for very young children and failed because of difficulty with sterilization and the screaming fits when the child had to give up the toy!)

Defining decisions & results
Next, each of the issues defined earlier were considered and the decisions required to explore them chosen. Coupled with these decisions, the results are needed to be generated to show their effect. I believe that to deliver learning there must be an implicit causal link between decisions and results. (Implicit rather than explicit since the participants have to think through and explore possible links.)

Creating models linking decisions & results
After defining decisions and the associated with them, the next stage is to create, test and calibrate the models that link the two. (Calibration means that the models' responses to decisions are realistic, stable and economic difficulty increases as the simulation progresses (see economic calibration next).

Ramping workload and learning
Figure 14 shows how the workload and learning of the simulation can be ramped using three mechanisms: Economic Calibration, Complexity and Tutor Intervention. Additionally, it shows how this increases learning (understanding) and affects feelings.

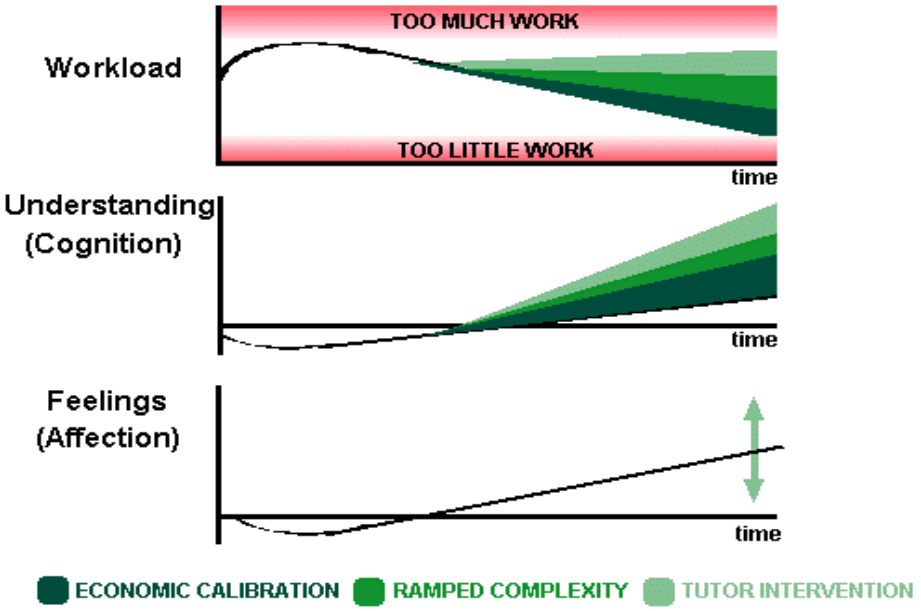

Figure 14: Ramping Complexity

For example, for the entrepreneurial simulation, the economic situation is **calibrated** to provide adequate cash for the first few trading periods. However, as sales grow and as the annual peak in sales is reached, the amount of cash is too little to fund the business forcing the participants (at that time) to consider cash rationing and new sources of funds. However, this happens after the participants have gained knowledge of market demand and are better able to forecast sales and the ability to make Cuddl-Etoys.

As the entrepreneurial simulation progresses, complexity is ramped by increasing the range of products sold and introducing the need to budget sales, costs, profits and cash after the first year's trading.

If the simulation is a tutor mediated (where the trainer processes the decisions) a further way to ramp complexity is for the tutor to intervene and manually adjust economic factors, market sizes and the reports provided to teams.

Create Tutor Support System

The final step is to build into the simulation software routines and reports to support the tutor [6]. This support (Figure 15) falls into six categories.

	Administration	Facilitation	Learning Management
Help System	n	n	
Decision Screen	n	n	n
Explanations	n	n	
Comments			n
Tutor's Audit		n	n
Team Commentary		n	n

Figure 15: Tutor Support Elements

The **Help System** comprises several elements: help with using the software, help with the current task, advice on the current report or decision area, definition of terms, an on-line manual and guidance on running a business. For the entrepreneurial simulation, because of the participants' backgrounds and the way the simulation was to be used, the help system had to be very comprehensive. (If the simulation were to be used by the tutor or if the participants were more experienced or knowledgeable, then the help system could be much smaller.)

The **Decision Screen** ensures that inappropriate or mistaken decisions are identified and, if appropriate, rejected. Also, unusually large or small values are flagged and commented on, as are decisions that might be inappropriate in the current business situation. (For instance, a major capital investment while experiencing liquidity problems would be identified and the team warned.) For the entrepreneurial simulation these comments were designed to replicate feedback from suppliers, banks etc.

Explanations provide information about background operational and financial calculations. So, for instance, the Balance Sheet might show the current value of Fixed Assets but an explanation would be available showing how this was calculated showing the previous period's fixed assets, assets purchased and disposed of and depreciation. Explanations allow the participants or the tutor to answer questions about the way results are calculated on a need to know basis without *drowning* participants in data.

Comments are qualitative comments on operation, strengths and weaknesses. These are deliberately *fuzzy* and are designed to replicate views of staff etc. For the entrepreneurial simulation, an additional, optional source of comments was a Great Aunt who provided seed-money and had considerable business experience. This provided a way of coaching the students and providing business knowledge - but only if they asked for it (and budgeted time to visit the Great Aunt)!

The **Tutor's Audit** provides comparative highlights across all teams and is designed to help the trainer identify problems (cognitive and affective) and manage the learning process through proactive feedback. Also, it provides for the trainer explicit information showing the links between decisions and results. By doing this the trainer can help coach teams and advise them if necessary.

The **Team Commentaries** provide team specific analyses of team performance. With the entrepreneurial simulation, this commentary was provided automatically at the end of the simulation as a record and summary of the activity and to form the basis of discussion at the review.

Typically, a Tutor Support System *doubles* the size of the simulation model and the associated databases.

Computer Aspects

When implementing the simulation on a computer there are two issues that need to be considered.

- Customization and Tailorability
- Software Development

Customization and Tailorability

Even after a simulation has been completed there are occasions where it must be customized or tailored. For instance, financial and business terminology differs from company to company and from country to country. So, it may be appropriate for a multinational or conglomerate to use different terminology for different areas of the business.

Also, different groups within the business and changing corporate focus means that the timing and scope of decisions and report differ. For example, recently a large UK bank changed its corporate focus and so the issues addressed by a simulation that they were using were not appropriate. However, by changing the sequence of decisions and the reports produced, the simulation was refocused. In another instance, an organization wanted to use a simulation as part of an assessment center and this involved producing additional reports to help the assessors identify assessees' strengths and weaknesses and identify the issues that the assessees should be acting on.

To ensure the greatest flexibility it is good practice to drive the simulation from a database [7] with separate databases for each version of the simulation.

Software Development

There are several software development paradigms:

- Spaghetti or OTF (On-the-fly) programming
- Object Oriented programming
- Simulator "shells"

Software designers generally see **spaghetti** or **OTF** programming as *a bad thing.* However, simulation development differs from conventional software development where it is possible to fully specify the software before starting to design it. It is a creative and iterative process. As the development proceeds the ideas of how to deliver learning evolve and so the software is revisited and refined. This leads to "on-the-fly" programming. However, provided the software is structured and fully documented the risks are minimized.

Another way of ensuring software quality and reducing development costs is to use **software objects** [8] wherever possible. For instance, several of the models developed for the entrepreneurial simulation were copied from other simulations. Often, basic financial models (such as the Income Statement, Balance Sheet or Cash Flow) are common to many simulations.

Finally, software quality can be ensured and development times more than halved by using a **software shell** (Figure 16). This divides the simulator into two parts - the simulation model and associated data and a simulation shell. The shell manages the processing cycle, decision entry, reporting and help. Typically, a simulation shell accounts for ninety to ninety-five percent of the software with the model accounting for the remaining five to ten percent. Also, unlike the model, a simulation shell lends itself to being fully specified before coding is started.

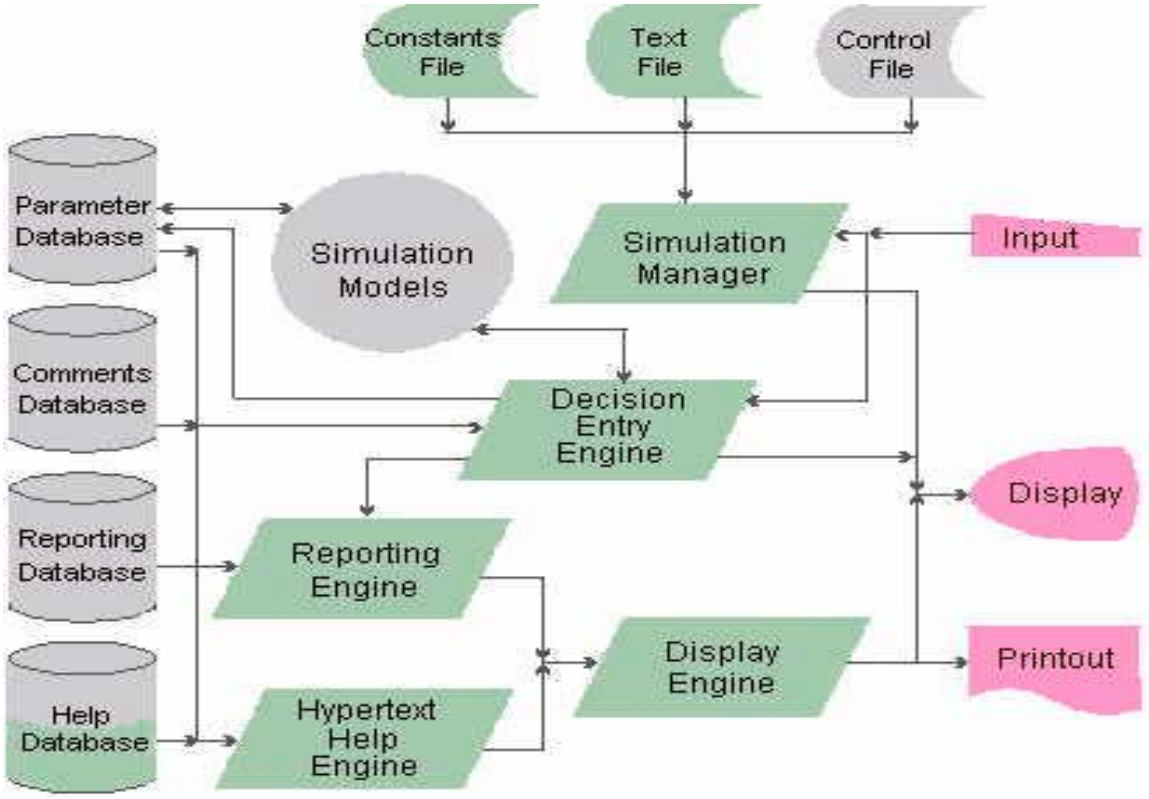

Figure 16: Example of a simulation shell architecture

Specifying & Choosing

Specifying and choosing consists of the same initial steps as described for the engineered design approach (Figure 9) with one addition - deciding whether to make or buy. In other words, having decided the target audience, objectives, duration and the issues to be addressed, you need to decide whether to develop a new simulation or buy an existing one.

1. Specify Target Audience
2. Specify Development Objectives
3. Decide Duration
4. Define Issues
5. Decide Manner of Use
6. Make or Buy

Figure 17: Specification Stages

Make or Buy

The cheapest alternative is to **buy** an existing simulation. When doing this there are three considerations:

1. Business Modeled (replica, reflection or generic)
2. Provenance (use: academic or training)
3. Run it yourself or fully tutored.

1. **Business Modeled** - you have a choice between a simulation that attempts to replicate your business exactly (but this may be too complex, take too long and allow participants to reduce dissonance by saying "but our business is not like that"), one that is a reflection of your industry (and so replicates issues but not the business exactly) or one that models a generic business (such as manufacturing or service.) If you only wish to build an appreciation of business

or you have a mix of people from different industries the generic is probably a good choice. If you wish to explore strategic or tactical business issues the reflection is a good choice.

2. **Provenance** answers two questions; First was the simulation developed for use for academic education or on training courses - the design objectives are different [9]. Second, has the simulation been used in this way before? For instance, a simulation designed to be used spread over a course may be to complex and logistically difficult to be used in a single session where time is at a premium.
3. **Run it yourself or fully tutored** is the last question to ask when using a simulation. If the simulation is fairly simple (lasting a day or less) you should have no problem running it yourself. However, you should budget some preparatory time to become familiar with the software and the simulation. If the simulation is complex or involves a large number of teams (at, for instance, a conference) or you are only going to use it once, it is probably better to buy in the simulation fully tutored.

Depending on the simulation's duration, designing a new simulation can be a long and costly task. However there are several ways of reducing this.

First, it may be possible to customize a simulation by changing terminology. On one occasion, I spent half a day changing the terminology of a generic simulation to match that of the client. Half way through its use with the client's senior management one of the group's Managing Directors congratulated me on matching their company so precisely and opined that I had to have spent a very long time doing so!

Second, it may be possible to take an existing simulation and replace some of the models with new ones (leaving most models unchanged). On one occasion, a large training provider who had used one simulation for some time won a contract to deliver management training to several groups of Casino Managers. The basic market, resourcing and financial structure matched that of an existing simulation that they were using. And, this existing simulation was used but the pricing, promotion and variable cost models were replaced. As a results, instead of spending several months developing a new simulation, a suitable simulation was developed in a couple of weeks.

Finally, if it is necessary to create a completely new simulation, as described in the section on software development, using existing objects or a software shell can save time. For the entrepreneurial simulation (a totally new simulation), models were extracted from several simulations and their use probably saved 20% of development time. Also, if a shell exists then this can be used to eliminate having to develop the simulation manager, user interfaces, database managers, reporting, decision-entry and help engines. Having developed several simulations using shells I have found that they more than halve development time.

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